

**Radiation Test Report:
Total Dose Testing of AD524**

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NASA-GSFC

1. Introduction

This report details the response to total ionizing radiation dose of the AD524 instrument amplifier manufactured by Analog Devices. Testing was performed between July and December 2006.

2. Part Information

Table I contains the information on the parts tested.

Table II.

Part Information

Generic Part Number:	AD524
Full Part Number:	AD524SE/883B
Manufacturer:	Analog Devices
Lot Date Code (LDC):	0606 and 0502A
Quantity Tested:	5
Serial Numbers of Control Sample:	5
Serial Numbers of Radiation Samples:	1, 2, 3 and 4
Part Function:	Instrument Operational Amplifier
Part Technology:	Bipolar
Package Style:	20 terminal LCC
Test Equipment:	Parametric analyzer, power supply
Test Engineer:	J. Forney
Targeted Dose Rate:	20 mrad(Si)/s

3. Test Procedure

Total dose testing was performed by exposing the devices to gamma rays in a Co⁶⁰ cell at GSFC. The parts were at room temperature. Four parts were irradiated under bias. There was one control sample. The total dose radiation levels were 5, 10, 15, 20, 30 and 40 krad(Si). The target dose rate was approximately 20 mrads/s.

During irradiation, supply voltages were +/-15 V, the inputs were grounded and the outputs were left floating.

Initial electrical measurements were made on 5 samples using a parametric analyzer. After each radiation exposure, all five parts were electrically tested to determine if there were any changes in parametric values. Parametric values were measured for two values of gain (1 and 100) in order to be able to extract both the input and output offset voltages. All parts passed all parametric measurements up to 40 krad(Si).

4. Results

Results of the parametric measurements are shown in Tables II –VII below.

Table II
Positive Power Supply Current as a Function of Dose
(Specification ICC(V+) = 5E-03 A)

ICC (V+)							
TID	DUT1	DUT2	DUT3	DUT4	Control	Average	St. Dev
0	4.22E-03	4.41E-03	4.48E-03	4.45E-03	4.57E-03	4.39E-03	1.16E-04
5	4.41E-03	4.35E-03	4.19E-03	4.41E-03	4.60E-03	4.34E-03	1.04E-04
10	4.12E-03	4.25E-03	4.29E-03	4.29E-03	4.57E-03	4.24E-03	8.18E-05
15	4.08E-03	4.17E-03	4.24E-03	4.25E-03	4.57E-03	4.18E-03	8.10E-05
20	3.95E-03	4.16E-03	4.19E-03	4.21E-03	4.57E-03	4.13E-03	1.20E-04
30	3.92E-03	4.11E-03	4.17E-03	4.14E-03	4.57E-03	4.08E-03	1.09E-04
40	3.82E-03	4.10E-03	4.13E-03	4.10E-03	4.57E-03	4.04E-03	1.46E-04

Table III
Negative Power Supply Current as a Function of Dose
(Specification ICC(V-) = 5E-03 A)

ICC (V-)							
TID	DUT1	DUT2	DUT3	DUT4	Control	Average	St. Dev
0	-4.23E-03	-4.42E-03	-4.49E-03	-4.46E-03	-4.58E-03	-4.40E-03	1.15E-04
5	-4.39E-03	-4.33E-03	-4.17E-03	-4.39E-03	-4.58E-03	-4.32E-03	1.04E-04
10	-4.13E-03	-4.26E-03	-4.30E-03	-4.30E-03	-4.58E-03	-4.25E-03	8.22E-05
15	-4.08E-03	-4.18E-03	-4.25E-03	-4.26E-03	-4.58E-03	-4.19E-03	8.10E-05
20	-3.96E-03	-4.17E-03	-4.19E-03	-4.21E-03	-4.58E-03	-4.13E-03	1.16E-04
30	-3.93E-03	-4.11E-03	-4.17E-03	-4.14E-03	-4.58E-03	-4.09E-03	1.09E-04
40	-3.82E-03	-4.10E-03	-4.13E-03	-4.11E-03	-4.58E-03	-4.04E-03	1.47E-04

Table IV
Positive Input Bias Current as a Function of Dose
(Specification Ib(+) = 5.0E-08 A)

Bias Input (+)							
TID	DUT1	DUT2	DUT3	DUT4	Control	Average	St. Dev
0	-4.52E-09	4.75E-10	-7.15E-09	2.03E-10	3.40E-10	-2.75E-09	3.72E-09
5	2.20E-08	2.61E-08	2.01E-08	3.21E-08	4.62E-10	2.51E-08	5.28E-09
10	6.09E-08	6.80E-08	6.81E-08	8.03E-08	1.26E-09	6.93E-08	8.05E-09
15	1.10E-07	1.17E-07	1.25E-07	1.40E-07	1.24E-09	1.23E-07	1.30E-08
20	1.75E-07	1.88E-07	2.06E-07	2.24E-07	6.58E-10	1.98E-07	2.14E-08
30	2.80E-07	3.05E-07	3.31E-07	3.46E-07	4.56E-10	3.16E-07	2.91E-08
40	3.95E-07	4.50E-07	4.83E-07	4.92E-07	1.01E-09	4.55E-07	4.39E-08

Table V
Negative Input Bias Current as a Function of Dose
(Specification Ib(-) = 5.0E-08 A)

Bias Input (-)							
TID	DUT1	DUT2	DUT3	DUT4	Control	Average	St. Dev
0	-3.14E-09	-1.41E-09	-7.23E-09	-8.61E-10	1.82E-09	-3.16E-09	2.88E-09
5	1.93E-08	2.38E-08	2.09E-08	2.97E-08	1.85E-09	2.34E-08	4.57E-09
10	6.14E-08	6.47E-08	6.55E-08	7.88E-08	2.18E-09	6.76E-08	7.70E-09
15	1.09E-07	1.14E-07	1.22E-07	1.39E-07	2.19E-09	1.21E-07	1.31E-08
20	1.74E-07	1.86E-07	2.03E-07	2.21E-07	1.76E-07	1.96E-07	2.05E-08
30	2.79E-07	3.01E-07	3.28E-07	3.42E-07	1.59E-09	3.13E-07	2.81E-08
40	3.95E-07	4.46E-07	4.80E-07	4.86E-07	2.20E-09	4.52E-07	4.17E-08

Table VI
Input Offset Voltage as a Function of Dose
(Specification Vin-off = 2.5E-04 V)

Input Offset Voltage							
TID	DUT1	DUT2	DUT3	DUT4	Control	Average	St. Dev
0	1.15E-05	1.62E-06	2.23E-06	4.69E-05	1.90E-05	1.56E-05	2.14E-05
5	4.20E-05	2.48E-05	3.21E-05	2.77E-05	6.46E-06	3.17E-05	7.52E-06
10	4.22E-05	5.23E-05	4.51E-05	5.15E-05	5.09E-05	4.78E-05	4.92E-06
15	3.96E-05	4.55E-05	1.17E-05	4.24E-05	-5.05E-07	3.48E-05	1.56E-05
20	3.21E-05	1.60E-05	8.26E-06	2.83E-05	2.89E-05	2.12E-05	1.10E-05
30	5.49E-05	2.00E-05	2.06E-05	4.97E-05	4.10E-05	3.63E-05	1.86E-05
40	3.82E-05	-1.17E-05	-1.13E-05	-5.98E-05	-2.22E-06	-1.12E-05	4.00E-05

Table VII
Output Offset Voltage as a Function of Dose
(Specification Vout-off = 5E-03 V)

Output Offset Voltage							
TID	DUT1	DUT2	DUT3	DUT4	Control	Average	St. Dev
0	7.32E-04	2.98E-04	3.22E-04	3.47E-04	3.90E-05	4.25E-04	2.06E-04
5	8.42E-04	1.25E-04	1.72E-04	3.48E-04	-1.35E-05	3.72E-04	3.28E-04
10	-3.78E-04	-4.88E-04	7.26E-04	-1.08E-04	9.09E-05	-6.20E-05	5.49E-04
15	-6.60E-04	-5.15E-04	-8.88E-04	-1.58E-04	9.49E-05	-5.55E-04	3.06E-04
20	-1.15E-03	-7.04E-04	8.08E-04	-4.12E-04	4.89E-05	-3.65E-04	8.39E-04
30	-1.81E-03	-7.60E-04	9.21E-04	-3.30E-04	1.21E-04	-4.94E-04	1.13E-03
40	-2.08E-03	-8.72E-04	1.13E-03	-4.60E-04	9.78E-05	-5.71E-04	1.33E-03

5. Conclusion

The AD524's positive and negative input bias currents went out of specifications between 5 and 10 krad(Si). The other parametric values all remained within specifications.